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UNIT REQUIREMENTS FOR PRODUCING MARKET MILK IN DELAWARE.

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CHARACTER AND SCOPE OF THE WORK.

What does it cost to produce milk? Dairymen everywhere want an answer to this important question. To supply accurate information along this line the United States Department of Agriculture, through the Dairy Division of the Bureau of Animal Industry, began a series of field studies in 1915, which have been completed and bulletins published on the requirements for producing milk in typical market-milk sections of North Carolina, Indiana, Vermont, Washington, Louisiana, and Nebraska.

The project with which this bulletin deals was organized in Delaware in June, 1919. The milk from this section is sold as market milk in Philadelphia and Wilmington. The cost of producing milk depends in part on the sanitary conditions and equipment in the dairy and the care exercised in maintaining cleanliness and in keeping milk

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at low temperatures Cost of production thus varies somewhat, according to the grade of milk produced, and in view of that fact no farms producing either very high or very low grades were included in the work.

The herds and farms were typical of dairy farms in the section studied. The figures reported show the relation of the various factors involved in producing milk in this section and probably approximate the requirements of similar districts, but they do not apply to dairying in localities where other conditions and methods of management prevail. Here dairying is not the chief industry, for grain growing is the most common type of farming. A typical farm of 400 acres would have from 100 to 130 acres of wheat, from 60 to 100 acres of field corn, and possibly 3 to 8 acres of potatoes. This acreage with the wood lot and some waste land leaves only a limited space devoted to pasture and to the growing of crops for livestock.

METHODS USED IN OBTAINING DATA.

The figures are actual records obtained by regular monthly 24-hour visits to 15 farms during the first year, and 16 farms the second year. The work was continued for the second year on 13 of the 15 farms visited the first year.

On his regular monthly inspection tour the field agent arrived at the first farm of a group in time to observe the first labor operations connected with the evening chores. With watch in hand he noted and recorded the exact time each operation about the dairy was begun and ended. He verified the records of feeds that were being fed on the inspection day, recording the kind, quantity, cost, and description of each. The quantity of milk sold each month and the receipts therefrom were noted. In addition, the whole milk used by the proprietor and his help and fed to calves which were being raised was measured or weighed and used as a basis for determining the quantity kept on the farm during the month. Accurate data on the calves and first-hand information on methods of handling manure were also collected.

Each dairyman kept an itemized account of expenses which were incurred between the monthly visits, such as the purchase or sale of cows and hides, outside bull service, and other miscellaneous information relative to the herd. These items were recorded by the field agent.

When the work about the dairy had been completed for the day at the first farm and all information relative to the dairy business recorded, the field agent drove to the next farm in time to observe the labor operations connected with the evening chores. This program was followed each week, so that each farm under observation

was visited for a working day every 30 days throughout the one or two years it was under observation.

By obtaining records on every dairy regularly each month the influence of unusual circumstances at the time of any particular visit was lessened, and by using the records of all the herds for each month complete data for each month, season, and year were obtained. Data were obtained for two entire years in order to compare one year with the other in the same section and to increase the amount of data for study.

SEASONAL INFLUENCE OF WINTER AND SUMMER ON COST FACTORS.

Since the winter and summer seasons have a marked influence on the principal factors entering into the cost of producing milk, the results have been computed separately for those periods. The months from November to April, inclusive, represent the winter season and from May to October, inclusive, the summer season.

The various tables found in this bulletin are based upon the figures obtained during the two years of the study, and the weighted average of the 2-year records was used whenever it would more accurately express the result. The weighted average was obtained by giving to each item a weight proportionate to its importance in comparison with the other items making up the average.

DESCRIPTION OF HERDS.

During the first year, records were obtained on 15 herds. The size of the herds was determined by the number of cows kept in the herd for 12 "cow-months." "Cow-month" is a term used to express the record of one cow in the herd for one month. Computed on this basis, the first year's study included 248.7 cows, with an average yearly production of 5,556 pounds of milk averaging 3.6 per cent butterfat. The second year's study included 281.6 cows in 16 herds, with an average yearly production of 5,326 pounds of milk and an average butterfat test of 3.6. The Holstein breed in both grade and purebred animals far outnumbered all the other breeds combined. Some of the herds had a few Guernseys and Jerseys.

REQUIREMENTS FOR PRODUCING MILK.

Wherever possible, the requirements have been expressed in terms of pounds of feed and hours of labor so as to eliminate as much as possible the effect of fluctuating prices.

TABLE 1.—*Units required, except charge for management, for producing 100 pounds of milk in winter and in summer.*

Item.	Winter.		Summary of two winters.	Summer.		Summary of two summers.
	1919–20.	1920–21.		1919–20.[1]	1920–21.[2]	
Feed:						
Purchased concentrates.....pounds..	36.2	38.2	37.2	18.4	9.7	13.6
Home-grown grains.....do....	17.5	15.5	16.5	3.5	.6	1.9
Total concentrates.....do....	53.7	53.7	**53.7**	21.9	10.3	**15.5**
Hauling and grinding grain.....	$0.01	$0.01	$0.01	$0.003	.....	**$0.002**
Noncommercial roughage.....pounds..	81.4	95.7	88.3	4.1	3.9	4.0
Commercial carbohydrate hay.....do....	13.3	28.8	20.8	2.3	1.0	1.6
Commercial legume hay.....do....	5.9	4.2	5.1	1.8	.2	.9
Total dry roughage.....do....	100.6	128.7	**114.2**	8.2	5.1	**6.5**
Silage and other succulent roughage.....pounds..	76.2	106.6	**91.0**	12.5	5.1	**10.3**
Bedding.....do....	17.4	18.4	**17.9**	4.1	2.8	**3.4**
Pasture.....	$0.04	$0.09	$0.06	$0.47	$0.49	**$0.48**
Labor:						
Human.....hours..	2.6	2.7	**2.6**	2.7	2.4	**2.5**
Horse.....do....	.5	.5	**.5**	.5	.3	**.4**
Other costs:						
Building charges.....	$0.23	$0.28	$0.25	$0.26	$0.23	$0.25
Equipment charges and dairy supplies.....	.09	.12	.10	.10	.10	.10
Herd charges: Taxes, insurance, veterinary service, medicines, and disinfectants.....	.10	.07	.08	.11	.06	.08
Interest on cow investment.....	.12	.23	.17	.13	.19	.16
Cost of keeping bull.....	.14	.19	.16	.12	.15	.14
Motor-truck charge.....	.03	.02	.03	.03	.02	.02
Cash hauling of milk.....	.....	.....	.....	.003	.....	.....
Total other costs, except depreciation on cows...	.71	.91	.79	.753	.75	.75
Depreciation on cows.....	.12	.36	.24	.14	.30	.23
Total other costs.....	$0.83	$1.27	**$1.03**	$0.893	$1.05	**$0.98**

[1] The summer season of 1919–20 consisted of June, July, August, September, and October of 1919 and May of 1920.

[2] June, July, August, September, and October of 1920 and May of 1921.

NOTE.—The summaries of the unit requirements are printed in bold-faced type for convenient reference.

During the winter a large quantity of grain was fed for each 100 pounds of milk produced. The decreased quantity of grain fed during the second summer as compared with the first summer should be noted.

TABLE 2.—*Number of cows, average production, and requirements for keeping a cow during each season and for the entire year, except charge for management.*

Item.	Winter.	Summer.	Entire year.
Number of cows.....	520.0	540.5	530.3
Average production per cow.....pounds..	2,725	2,714	5,439
Feed:			
Purchased concentrates.....do....	1,014	368	1,382
Home-grown grains.....do....	451	52	503
Total concentrates.....do....	1,465	420	1,885
Hauling and grinding grain.....	$0.30	$0.04	$0.34
Noncommercial roughage.....pounds..	2,407	108	2,515
Commercial carbohydrate hay.....do....	568	42	610
Commercial legume hay.....do....	139	25	164
Total dry roughage.....do....	3,114	175	3,289

TABLE 2.—*Number of cows, average production, etc.*—Continued.

Item.	Winter.	Summer.	Entire year.
Feed—Continued.			
Silage and other succulent roughage.....pounds..	2,479	281	2,760
Bedding.....do....	486	92	578
Pasture.....	$1.75	$12.93	$14.68
Labor:			
Human.....hours..	71.9	68.2	140.1
Horse.....do....	13.1	10.7	23.8
Other costs:			
Building charges.....	$6.93	$6.67	$13.60
Equipment charges and dairy supplies.....	2.73	2.63	5.36
Herd charges: Taxes, insurance, veterinary service, medicines, and disinfectants.....	2.29	2.20	4.49
Interest on cow investment.....	4.72	4.54	9.26
Cost of keeping bull.....	4.45	3.76	8.21
Motor-truck charge.....	.72	.75	1.47
Cash hauling of milk.....	.....	.04	.04
Total of other costs except depreciation on cows.....	21.84	20.59	42.34
Depreciation on cows.....	6.42	6.17	12.59
Total of other costs.....	28.26	26.76	55.02

CREDIT FOR CALVES.

The large credit of 95 calves for each 100 cows in the herds during the first year was greater than one would ordinarily expect. It was due to a considerable number of cows being sold out of the herds a few months after freshening.

During the second year calves brought lower prices, thus reducing the income from that source.

TABLE 3.—*Credits by years and by seasons for calves produced.*

Item.	Credit by years.		Credit by seasons.	
	1919–20.	1920–21.	Both winters.	Both summers.
Number of calves.....	236	247	272	211
Total value of calves.....	$3,929.96	$3,275.90	$3,828.76	$3,377.10
Average value of calves.....	16.65	13.26	[1] 14.08	[1] 16.01
Calves per cow.....	.95	.88	[1].52	[1].39
Credit per cow.....	$15.80	$11.63	[1] $7.36	$6.25
Credit per 100 pounds of milk.....	0.017 of 1 calf.	0.016 of 1 calf.	0.019 of 1 calf.	0.014 of 1 calf.

[1] These figures are the weighted averages for the respective seasons.

CREDIT FOR MANURE.

Three factors were considered in determining the credit for manure: (1) The proportion of fertilizing constituents in the feed which was returned in the manure, as taken from standard tables; (2) the per cent of manure voided in the barn; and (3) the per cent of the fertilizing constituents saved in storing and handling.

A cow digesting her feed utilizes on the average approximately 25 per cent of the nitrogen, 30 per cent of the phosphorus, and 15 per cent of the potash contained in the feed. It is evident, then, that 75 per cent of the nitrogen, 70 per cent of the phosphorus, and 85 per cent of the potash are voided in the urine or in the solid portion of the manure.

Dairymen who wish to reduce their net cost of production should remember two important facts in regard to manure: First, that a large proportion of the fertility value represented by the purchase price of the feeds may be recovered by saving all the liquid and solid portions of the manure; and, second, that the urine is more valuable than the solid manure as a source of that high-priced plant food, nitrogen. One of the big losses in liquid manure on many farms is due to leaky floors in the stable.

TABLE 4.—*Credits for manure and fertilizing constituents during the two winters and the two summers.*

Item.	Winter.			Summer.		
	1919–20	1920–21	Average.[1]	1919–20[2]	1920–21[2]	Average.[1]
Total manure saved.....tons..	656.0	[3] 515.7	585.9	153.8	81.4	117.6
Manure per cow.....pounds..	5,269	3,806	4,506	1,238	558	870
Manure credited per 100 pounds of milk.....do....	180	150	165	47	20	32
	Winter average.			Summer average.		
	Nitrogen.	Phosphoric acid.	Potash.	Nitrogen.	Phosphoric acid.	Potash.
Fertilizing constituents in manure.....pounds..	6,035	2,226	4,922	1,211	447	988
Credit per cow.....do....	23.2	8.6	18.9	4.5	1.7	3.7

[1] The averages are weighted.
[2] See notes to Table 1.
[3] Not as large a proportion of the manure voided the second year was saved.

According to Table 4, an average of 4,506 pounds, or slightly over 2.2 tons, of manure was saved per cow during the winter six months. A 1,000-pound cow voids about 6½ tons of manure in six months. The difference between these two amounts shows the quantity which was voided in the yards or was lost in storing or handling. This was due to the fact that much of the manure, especially the liquid portion, was lost through the floors in the barns or allowed to leach away when stored in piles exposed to the weather. Only the manure which was or could have been saved by using reasonable care with the equipment available was credited to the cows. The quantity of manure dropped was approximated by keeping a record of the time the cows were actually in the barn.

A ton of average manure saved on the farms studied, according to the methods used for determining it, was estimated to contain the following fertilizing constituents:

	Pounds.
Nitrogen	10.3
Phosphoric acid	3.8
Potash	8.4

When the nitrogen in commercial fertilizers was worth 18 cents, phosphoric acid 5 cents, and potash 6 cents per pound, the fertilizing value of these ingredients in a ton of manure would have been $2.55.

REQUIREMENTS FOR KEEPING A BULL.

On most of the farms the bulls were fed a comparatively small quantity of grain. In summer they were generally allowed to run on pasture with the cows.

The large proportion of noncommercial roughage used, which consisted chiefly of corn fodder and stover, shows that the herd sires were fed as cheaply as possible. The yearly cost of keeping the bull was not low, however, due to the size of each of the items under "Other costs."

TABLE 5.—*Requirements for keeping a bull by seasons, based on averages obtained from the equivalent of 31 bulls.*

Item.	Winter.	Summer.	Entire year.
Feed:			
Purchased concentrates.....pounds..	408	289	697
Home-grown grain.....do....	210	72	282
Total concentrates.....do....	618	361	979
Noncommercial roughage.....do....	2,712	123	2,835
Commercial carbohydrate hay.....do....	474	554	1,028
Commercial legume hay.....do....	172	181	353
Total dry roughage.....do....	3,358	858	4,216
Succulent roughage.....do....	720	137	857
Bedding.....do....	20	16	36
Pasture.....	$1.08	$10.02	$11.10
Human labor.....hours..	12.1	9.1	21.2
Other costs:			
Insurance and interest on bull investment.....	$11.31	$11.46	$22.77
Bull's share of buildings.....	6.99	7.07	14.06
Depreciation.....	15.71	15.92	31.63
Total other costs.....	34.01	34.45	68.46
Credit for outside bull service.....	.....	2.43	2.43
Total other costs less outside bull service.....	34.01	32.02	66.03

FACTORS INVOLVED IN THE PRODUCTION OF MILK.

FEED.

Concentrates, in the meaning of this study, are grains and their by-products prepared for feeding.

Home-grown grains are concentrates grown on the farm or in the locality where fed.

Dry roughage includes various hays and other bulky feeds. Dry roughage is divided into the three following classes: *Noncommercial dry roughage* applies to coarse feeds, such as corn fodder and other roughages for which price quotations are not given in the trade papers. Hay or other dry roughage so foul with weeds or so damaged in curing as not to be readily salable was also classified under this heading. *Commercial legume hay* includes alfalfa, clover, and other marketable legume hays, when pure, or when so slightly mixed with grasses as not materially to affect the protein content. *Commercial carbohydrate hay* refers to all marketable hays except those classified as legume hay.

Succulent roughage consists of corn silage, potatoes, beets, and soiling crops.

The quantities of the various feeds used were obtained from actual weighings made by the field agent on his regular monthly visit to each farm.

Purchased concentrates were charged at the prices paid. The home-grown grains were given the farm price. Charges for hauling and grinding home-grown grain were not included in the price but were recorded separately. The value of silage was based upon the value of the grain and roughage in it, less the difference between the cost of harvesting the corn and the cost of putting it into the silo.

PASTURE.

The rent for permanent pasture was determined by adding to the interest on the unimproved value of the land the cost of maintaining fences and incidentals, such as seeding. Where stubble land was pastured after the grain had been harvested or when meadows were grazed after the hay had been removed, a charge was made equal to the rent value of permanent pasture for the month which best represented the quantity of feed obtained from the stubble or meadow.

Some of the herds had the run of cheap bottom-land pasture, worth about one-fifth the value of cultivated land. Two other herds were short of pasture practically all the time during the two years of study. This latter fact materially increased the cost of production.

LABOR.

Throughout this 2-year study the cost of management has not been included in the charge for labor, because no satisfactory basis has been found upon which to make this charge. The physical labor of the manager was charged up at the same rate per hour as he would have had to pay if he had hired a man of equal skill to take his place.

TABLE 6.—*Per cent of labor performed and hours per 100 pounds of milk for each class of help.*

Class of labor.	Winter.				Summer.			
	Distribution of work performed.			Labor for 100 pounds of milk.	Distribution of work performed.			Labor for 100 pounds of milk.
	1919–20	1920–21	Average.	Average.	1919–20[1]	1920–21[1]	Average.	Average.
	Per cent.	*Per cent.*	*Per cent.*	*Hours.*	*Per cent.*	*Per cent.*	*Per cent.*	*Hours.*
Managers	28.1	28.4	28.2	0.74	25.2	28.5	26.9	0.67
Hired men	68.3	67.7	68.0	1.80	67.2	60.6	63.7	1.60
Total man labor	96.4	96.1	96.2	2.54	92.4	89.1	90.6	2.27
Women	1.2	1.5	1.4	.04	1.8	1.4	1.6	.04
Boys and girls	2.4	2.4	2.4	.06	5.8	9.5	7.8	.20
Total	100.0	100.0	100.0	2.64	100.0	100.0	100.0	2.51

[1] See notes to Table 1.

The production of market milk in this section is mostly a man's job, as is shown in Table 6. In winter men performed 96.2 per cent of the work about the dairy. But in summer, especially during the vacation months, boys and girls performed more of the work, thus reducing the proportion of man labor for the summer season to 90.6 per cent.

Work about the dairy is divided into three groups—production, handling, and hauling to the shipping platform. Production includes feeding, milking, and the general care of the herd. Handling comprises such items as washing utensils, cooling the milk, and getting it ready for hauling. In this section part of the milk was shipped by train and part transported by large motor trucks to the city.

TABLE 7.—*Human labor used in producing, handling, and hauling 100 pounds of milk to the shipping platform.*

Kind of work.	Winter.				Two winters.		Summer.				Two summers.	
	1919–20.		1920–21.				1919–20.[1]		1920–21.[1]			
	Hours.	*Per ct.*	*Hours.*	*Per ct.*	*Hours.*	*Per ct.*	*Hours.*	*Per ct.*	*Hours.*	*Per ct.*	*Hours.*	*Per ct.*
Production	2.2	84.7	2.2	82.0	2.2	83.3	2.1	76.0	1.9	79.0	2.0	77.6
Handling	.1	4.6	.2	5.5	.1	5.1	.2	8.4	.2	7.5	.2	7.9
Hauling	.3	10.7	.3	12.5	.3	11.6	.4	15.6	.3	13.5	.3	14.5
Total	2.6	100.0	2.7	100.0	2.6	100.0	2.7	100.0	2.4	100.0	2.5	100.0

[1] See notes to Table 1.

OTHER COSTS.

Under the heading of "Other costs" are grouped miscellaneous charges, such as interest, taxes, insurance, and depreciation on the herd, buildings, and equipment; also the cost of keeping the bull and similar items.

In Delaware the farm property is assessed for taxation by four men who visit each farm. These men place a separate market value on the different grades of raw land, such as swamp, tillable, etc. The value of the buildings is appraised, as is also the market value of the livestock. Since values are not placed on the separate buildings and on cows individually by these assessors, the field man had another appraiser visit each herd and value each building and cow separately, using the total figures of the assessors as a basis.

BUILDINGS.

The first column of Table 8 shows that the 2-year average investment in dairy buildings, including silos, was $148.14 per cow. The investment in buildings the first year was $111.07 per cow. The higher investment for the 2-year average was due to one dairyman constructing a barn and two tile silos which cost $25,500. The 2-year average investment in buildings, not including the large barn and silos, would have been $100.05 per cow. This investment is also higher than it would have been had not a number of other barns and silos been erected during recent years when prices were high; also a number of tile silos were erected which had large initial costs.

The depreciation of the buildings was based upon their remaining years of usefulness. Insurance charges were obtained from the insurance agents. The cost for upkeep and repairs was obtained by keeping an actual record of expenditures during the year.

The footing of the first column shows that the total of the costs against buildings amounted to 9.7 per cent of the capital invested in buildings. The other footings show corresponding percentage relationships.

TABLE 8.—*Per cent relationship between "other costs" and capital invested.*

Item.	Buildings.	Equipment.	Cattle.	Total.
Capital invested	$78,560.82	$8,566.18	$82,158.00	$169,285.00
Capital invested, per cow	148.14	16.15	154.93	319.22
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
Interest	4.9	5.3	6.0	
Depreciation	2.9	22.3	8.1	
Taxes	.9		1.3	
Insurance	.3			
Upkeep and repairs	.7	1.1		
Milking-machine repairs		.2		
Total	9.7	28.9	15.4	[1] 13.5

[1] Per cent which the expenses listed bear to total investment.

EQUIPMENT.

A monthly record of repairs and renewals of equipment was kept. The amounts spent for dairy supplies were also recorded monthly and amounted during the year to 69 cents per cow.

CATTLE.

The cows had an average inventory value of $154.93. Purebred cows were inventoried at fair prices for grade cows of similar producing ability, and the calves dropped by purebred cows were inventoried at corresponding grade values. Inventories were taken at the beginning and end of each year. The depreciation or appreciation in value of cows was obtained in the following manner: The values of heifers freshening or cows purchased during the year were added to the first inventory and the values of cows or hides sold during the year were added to the inventory at the end of the year. The difference between the two inventories, after these additions, represented the depreciation or appreciation on the herd for the year.

The feed, labor, and "other costs" of keeping the herd sires were kept separate, so that they would be available for study.

Interest was charged at 6 per cent, the prevailing rate in the section. Records were kept of the actual amounts of money spent during the year for veterinary services, medicines, and disinfectants. These expenditures amounted to 87 cents per cow per year.

PERCENTAGE COMPARISON OF FACTORS INVOLVED IN MILK PRODUCTION.

How much more did it cost to produce milk in winter than in summer? What caused the variation in cost? Did the credit for calves and manure equal the debit for either labor or "other costs"? Table 9 answers these questions for the section studied.

TABLE 9.—*Per cent of the total costs represented by feed, labor, and "other costs," by seasons.*

Item.	Winter.	Summer.	Entire year.
	Per cent.	*Per cent.*	*Per cent.*
Feed and bedding cost	35.9	8.9	44.8
Pasture	.9	7.3	8.2
Feed, bedding, and pasture cost	36.8	16.2	53.0
Labor cost	8.6	8.1	16.7
Other costs, except herd inventory variation	11.8	11.5	23.3
Total cost except herd inventory variation	57.2	35.8	93.0
Depreciation on herd	3.5	3.5	7.0
Total cost of production	60.7	39.3	100.0
Credits:			
Calves	4.0	3.5	7.5
Manure	4.7	1.0	5.7
Total credits	8.7	4.5	13.2

An examination of the first two columns of Table 9 shows that the decrease in the cost of feed in summer was the principal cause of the difference in cost between winter and summer.

The credits for calves and manure for the year equal 13.2 per cent of the total cost of production, whereas labor amounted to 16.7 per

cent of the total cost. "Other costs," including depreciation on the herds, amounted to 30.3 per cent. This shows that calves and manure failed by a small margin to equal the cost of labor and by a wide margin to balance the "other costs," including depreciation on the herds.

AVERAGE COMPARED WITH BULK-LINE COSTS.

If the net cost of producing milk on various farms is tabulated in an ascending scale, together with the percentage of the whole quantity of milk produced at these separate costs, one or possibly more points will be shown at or below which a large proportion of the milk is produced. The point or line of demarcation selected is called the "bulk" line. It is usually placed where it will include between 80 and 90 per cent of the volume of milk produced.

TABLE 10.—*Net cost, quantity, and per cent of milk produced by each herd during two winters and two summers.*

Winter, 1919–20.					Winter, 1920–21.				
Herd No.	Cost per 100 pounds.	Milk produced.			Herd No.	Cost per 100 pounds.	Milk produced.		
		Quantity.	Per cent of total.	Cumulative per cent.			Quantity.	Per cent of total.	Cumulative per cent.
		Pounds.	*Per cent.*	*Per cent.*			*Pounds.*	*Per cent.*	*Per cent.*
608	$2.62	87,053	12.0	12.0	617	$2.10	36,640	5.3	5.3
605	2.73	33,431	4.6	16.6	618	2.49	44,824	6.5	11.8
602	2.94	105,963	14.6	31.2	607	2.62	11,039	1.6	13.4
606	2.99	53,315	7.3	38.5	602	2.98	84,343	12.3	25.7
603	3.03	82,615	11.4	49.9	[2]	[2] 3.02			
612	3.07	34,912	4.8	54.7	606	3.05	69,622	10.1	35.8
[1]	[1] 3.36				619	3.10	31,203	4.5	40.3
[2]	[2] 3.43				613	3.25	32,194	4.7	45.0
616	3.53	42,974	5.9	60.6	610	3.41	50,153	7.3	52.3
610	3.53	48,090	6.6	67.2	609	3.43	35,172	5.1	57.4
614	3.77	45,865	6.3	73.5	611	3.44	25,010	3.6	61.0
607	3.88	21,181	2.9	76.4	608	3.55	62,016	9.0	70.0
604	3.88	60,981	8.3	84.7	[1]	[1] 3.70			
609	4.07	23,634	3.2	87.9	614	3.93	51,022	7.4	77.4
613	4.14	41,844	5.8	93.7	616	4.01	46,061	6.7	84.1
615	4.20	28,529	3.9	97.6	604	4.96	46,418	6.7	90.8
611	5.53	17,238	2.4	100.0	615	5.88	23,414	3.4	94.2
					603	7.95	40,087	5.8	100.0
Summer, 1919–20.[3]					Summer, 1920–21.[3]				
610	$1.49	39,749	6.1	6.1	617	$1.11	51,326	6.3	6.3
608	1.83	52,016	8.0	14.1	610	1.27	49,454	6.1	12.4
606	1.90	43,229	6.6	20.7	606	1.32	61,341	7.6	20.0
603	2.01	69,523	10.6	31.3	619	1.46	50,590	6.2	26.2
616	2.01	41,097	6.3	37.6	618	1.53	62,833	7.7	33.9
607	2.12	24,997	3.8	41.4	607	1.55	25,524	3.1	37.0
612	2.20	29,056	4.4	45.8	611	1.79	44,409	5.5	42.5
[1]	[1] 2.40				602	1.92	71,591	8.8	51.3
615	2.47	36,095	5.5	51.3	609	1.95	35,066	4.3	55.6
609	2.49	22,155	3.4	54.7	616	1.99	56,484	7.0	62.6
602	2.52	91,560	14.0	68.7	613	2.03	35,940	4.4	67.0
611	2.53	28,423	4.4	73.1	[1]	[1] 2.19			
605	2.58	32,953	5.0	78.1	608	2.43	65,825	8.1	75.1
613	2.79	54,156	8.3	86.4	614	3.13	31,703	3.9	79.0
604	3.19	50,343	7.7	94.1	[2]	[2] 3.16			
[2]	[2] 3.32				615	3.38	39,252	4.8	83.8
614	3.84	38,610	5.9	100.0	603	3.64	82,232	10.1	93.9
					604	4.18	49,475	6.1	100.0

[1] Average net cost. [2] Average income from milk. [3] See notes to Table 1.

In the scale of costs for the first winter in Table 10, the location for the bulk line on this basis is immediately following $3.88. It will be noted that 84.7 per cent of the milk was produced at $3.88, or less, per 100 pounds.

The schedule of costs for the second winter shows a sharp increase in price after 84.1 per cent of the volume of milk was produced. Thus at $4.96 only 6.7 per cent more milk was produced but at an increased cost of 95 cents per 100 pounds. A similar sharp increase also exists at $5.88, the increase in volume of milk at this cost being only 3.4 per cent and the increase in cost amounting to 92 cents.

These results emphasize two equally important facts: First, that the income from milk in winter failed by a large margin to equal the cost of production for the bulk-line supply; and, second, that there was a wide range in costs between the more efficient dairymen and the higher cost producers. Where a winter supply of milk is needed, the price must be high enough to stimulate increased production to the necessary demand.

In the dairy business, as in other industries, the net income depends upon net profit made from milk sold and upon the volume of milk sold.

MONTHLY DISTRIBUTION OF FACTORS IN MILK PRODUCTION.

How did the quantity of milk produced in summer compare with that in winter? Did the monthly income received for milk sold fluctuate fairly uniformly with the quantity sold? Did the dairymen receive the higher income during those months when it cost the most to produce milk? Table 11 gives information on these queries. Yearly figures were used as the basis for computing percentages.

TABLE 11.—*Distribution by months of milk prices, milk sold and used, feed cost, and labor required.*

Month and season.	Income per 100 pounds of milk.	Income from milk sold and used.	Milk sold and used.	Feed, pasture, and bedding cost.	Pasture and bedding cost minus manure and bedding credits.	Human labor.		Horse labor.	
						Per 100 pounds of milk.	Per cow.	Per 100 pounds of milk.	Per cow.
1919–20.		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Hours.*	*Hours.*	*Hours.*	*Hours.*
May	$3.23	10.3	10.9	5.3	4.9	2.1	12.5	0.3	2.0
June	3.03	9.0	10.1	4.5	4.1	2.4	13.4	.4	2.2
July	3.07	6.4	7.1	4.6	4.2	3.1	12.5	.5	2.2
August	3.45	6.5	6.4	4.7	4.3	3.2	11.6	.7	2.5
September	3.73	7.2	6.5	5.6	5.6	3.1	10.9	.6	2.0
October	3.98	7.1	6.1	6.1	5.7	3.1	10.3	.4	1.2
Summer	3.36	46.5	47.1	30.8	28.4	2.7	11.8	.5	2.0
November	3.62	7.4	6.9	7.8	6.0	2.7	10.0	.3	1.1
December	3.54	8.5	8.1	11.9	10.1	2.8	12.4	.6	2.4
January	3.46	9.5	9.4	12.9	11.1	2.7	14.1	.5	2.6
February	3.36	9.3	9.4	11.9	10.1	2.5	13.2	.4	2.4
March	3.33	9.8	10.0	12.5	10.7	2.6	14.5	.6	3.4
April	3.36	9.0	9.1	12.2	10.4	2.5	12.4	.4	1.9
Winter	3.43	53.5	52.9	69.2	58.4	2.6	12.8	.5	2.3
Year	3.40	100.0	100.0	100.0	86.8	2.7	12.3	.5	2.2

TABLE 11.—*Distribution by months of milk prices, etc.*—Continued.

Month and season.	Income per 100 pounds of milk.	Income from milk sold and used.	Milk sold and used.	Feed, pasture, and bedding cost.	Pasture and bedding cost minus manure and bedding credits.	Human labor.		Horse labor.	
						Per 100 pounds of milk.	Per cow.	Per 100 pounds of milk.	Per cow.
1920–21.		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Hours.*	*Hours.*	*Hours.*	*Hours.*
May	$2.48	8.2	10.2	5.2	5.0	2.2	12.3	.3	1.7
June	3.11	9.2	9.2	5.1	4.9	2.4	11.2	.4	2.0
July	2.87	9.5	10.2	4.2	4.0	2.1	10.9	.3	1.6
August	3.38	9.4	8.6	4.7	4.5	2.6	11.5	.3	1.4
September	3.52	9.3	8.1	5.5	5.3	2.4	9.6	.4	1.6
October	3.85	9.6	7.8	5.8	5.7	2.5	10.2	.3	1.3
Summer	3.15	55.2	54.1	30.5	29.4	2.4	10.9	.3	1.6
November	3.86	9.1	7.3	9.0	7.9	2.4	9.3	.3	1.2
December	3.02	6.6	6.8	12.1	11.0	2.8	11.2	.5	2.0
January	2.86	6.6	7.0	12.7	11.6	2.9	11.7	.7	2.8
February	2.90	6.2	6.7	11.8	10.7	3.0	11.1	.7	2.6
March	2.87	7.6	8.2	13.3	12.1	2.8	12.6	.5	2.1
April	2.74	8.7	9.9	10.6	9.4	2.2	12.0	.3	1.8
Winter	3.03	44.8	45.9	69.5	62.7	2.7	11.3	.5	2.1
Year	3.10	100.0	100.0	100.0	92.1	2.5	11.1	.4	1.8

The second column shows that 46.5 per cent of the yearly income for the first year was obtained during the summer six months. The third column shows that this income in summer was received in return for the sale of 47.1 per cent of the yearly volume of milk produced.

The fourth column indicates that this volume of milk was obtained for 30.8 per cent of the yearly gross feed cost.

In winter it took 69.2 per cent of the gross yearly feed cost to produce 52.9 per cent of the yearly volume of milk which brought in 53.5 per cent of the yearly income received from it. The conclusion drawn from these figures and from those for the second year is that income and volume of milk sold closely followed each other, but income and gross feed cost required to produce milk did not follow each other.

SUMMARY.

In this investigation the requirements for producing milk were obtained from records covering two 1-year periods. During the winter months the requirements for producing 100 pounds of milk having an average butterfat test of 3.6 per cent were: Concentrates, 53.7 pounds; hauling and grinding concentrates, $0.01; dry roughage, 114.2 pounds; silage and other succulent roughage 91 pounds; bedding, 17.9 pounds; pasture, $0.06; human labor, 2.6 hours; horse labor, 0.5 hour; total other costs except depreciation on cows, $0.79; depreciation on cows, $0.24.

During the summer months the requirements for producing 100 pounds of milk were: Concentrates 15.5 pounds, hauling and grinding concentrates $0.002; dry roughage, 6.5 pounds; silage and other succulent roughage 10.3 pounds; bedding 3.4 pounds; pasture $0.48; human labor 2.5 hours; horse labor 0.4 hour; total other costs except depreciation on cows $0.75; depreciation on cows $0.23. (See Table 1.)

The average production per cow per year was 5,439 pounds of milk and the requirements for keeping a cow one year were: Concentrates 1,885 pounds; hauling and grinding concentrates $0.34; dry roughage 3,289 pounds; silage and other succulent roughage 2,760 pounds; bedding 578 pounds; pasture $14.68, human labor 140.1 hours; horse labor 23.8 hours; total other costs except depreciation on cows $42.43; depreciation on cows $12.59. (See Table 2.)

There was a credit, per year, of 0.91 of one calf for each cow. (See Table 3.) The credit for manure per cow amounted to 5,376 pounds. (See Table 4.) It was estimated that a ton of this manure contained 10.3 pounds of nitrogen, 3.8 pounds of phosphoric acid, and 8.4 pounds of potash.

In the winter season 28.2 per cent of the work was performed by the managers, 68 per cent by hired men, 1.4 per cent by women, and 2.4 per cent by boys and girls. During the summer 26.9 per cent was performed by the managers, 63.7 per cent by hired men, 1.6 per cent by women, and 7.8 per cent by boys and girls. (See Table 6.)

In winter 83.3 per cent of the labor was expended for production, 5.1 per cent for handling, and 11.6 per cent for hauling. During the summer 77.6 per cent of the labor was expended for producing milk, 7.9 per cent in handling, and 14.5 per cent in hauling the milk. (See Table 7.)

The capital invested in buildings amounted to $148.14 per cow. The equipment investment per cow was $16.15 and the investment in the cows themselves amounted to $154.93 per cow. The annual charges for interest, depreciation, taxes, and similar items on buildings amounted to 9.7 per cent of the capital invested. The equipment expense amounted to 28.9 per cent of the investment in equipment, and the expenses against the cows themselves amounted to 15.4 per cent of the investment. The combined yearly charge for buildings, equipment, and herd was 13.5 per cent of the total capital invested in them. (See Table 8.)

Fifty-three per cent of the cost of producing milk was due to feed, bedding, and pasture; 16.7 per cent to labor, 7 per cent to depreciation on cows, and 23.3 per cent to other costs. There was a credit of 7.5 per cent for calves and 5.7 per cent for manure. (See Table 9.)

The average costs of producing milk were $3.36 and $3.70 per 100 pounds for the two winters, respectively. The costs for the two respective summers were $2.40 and $2.19 per 100 pounds. (See Table 10.) During the first winter it took 69.2 per cent of the gross yearly feed, pasture, and bedding cost to produce 52.9 per cent of the yearly volume of milk, which brought in 53.5 per cent of the yearly income received from it. (See Table 11.) These figures and those obtained for the second year show that the income and volume of milk sold followed each other closely, but that the income and gross feed cost required to produce milk varied considerably.

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